

## CLAIMS

1. A slip coupling for engaging a pipe having a longitudinal axis, a smooth outer wall, and an end opening, said slip coupling comprising:

(a) an outer casing, said outer casing having (1) an interior passageway, said interior passageway sized and shaped to fit therein at least some length of said pipe, and (2) a flanged end;

(b) a split ring, said split ring comprising first and second ring portions, said first and second ring portions each having an interior wall, said interior wall further comprising at least one gasket seat, said first and second ring portions adjustably movable between an open position wherein said first and second rings open to allow attachment to or removal from said pipe, and a closed position wherein said first and second ring portions are securable in close fitting engagement around said pipe; and

(c) a gasket, said gasket located at said at least one gasket seat in said inner wall of said first and said second ring portions, said gasket adapted to slidably receive said smooth outer wall of said pipe and to provide a fluid tight seal between said split ring and said smooth outer wall of said pipe.

2. The apparatus as set forth in claim 1, further comprising an outer casing backing flange, said outer casing backing flange sized and shaped for close fitting engagement over said flanged end of said outer casing.

3. The apparatus as set forth in claim 1 or in claim 2, wherein said first and second ring portions, when in said closed position, comprise a split ring having a substantially annular ring shape which extends between an outer wall and said interior wall.

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4. The apparatus as set forth in claim 3, wherein said split ring further comprises a plurality of longitudinally extending bolt through apertures defined by bolt hole interior walls.

10 5. The apparatus as set forth in claim 4, further comprising a plurality of fasteners having shaft portions, and wherein said backing flange comprises a plurality of fastener through apertures, wherein each fastener through aperture is defined by an aperture edge wall portion, and wherein said shaft portions of said fasteners are sized and shaped for fitting through one of said fastener through  
15 apertures in said backing flange and through a companion axially aligned bolt through aperture in said split ring, and wherein at least one of said plurality of fasteners is adjustably tightenable to secure said backing flange and said split ring each toward the other.

20 6. The apparatus as set forth in claim 3, wherein eight through apertures are provided in said split ring.

7. The apparatus as set forth in claim 1 wherein said gasket seat comprises a recess in said interior sidewall of said first and of said second ring portions.

8. The apparatus as set forth in claim 7, wherein said recess comprises an  
5 annular groove in said interior sidewall of said first and of said second ring portions.

9. The apparatus as set forth in claim 7, wherein said first and said second ring portions have an obverse side and a reverse side, and wherein said annular  
10 groove is centered between said obverse side and said reverse side.

10. The apparatus as set forth in claim 8, wherein said annular groove has a height  $H_A$  extending between a lower groove side and an upper groove side, and wherein said first and said second ring portions comprise an upper interior body  
15 portion above said upper groove side and a lower interior body portion below said lower groove side.

11. The apparatus as set forth in claim 10, wherein upper interior body portion extends between said obverse side of said first or of said second split ring portion  
20 and said upper groove side of said annular groove, and wherein said upper interior body portion has a thickness  $H_I$  equal to height  $H_A$  of said annular groove.

12. The apparatus as set forth in claim 10, wherein lower interior body portion extends between said reverse side of said first or of said second split ring portion and said lower groove side of said annular groove, and wherein said lower interior body portion has a thickness  $H_L$  equal to height  $H_A$  of said annular groove.

13. The apparatus as set forth in claim 1, further comprising an annular seal, and wherein split ring comprises an obverse side portion, and wherein said flanged end comprises a flange face portion, and wherein said annular seal is sized and shaped for sealing engagement with and compression between said flanged face portion and said obverse side of said split ring.

14. The apparatus as set forth in claim 13 or in claim 1, further comprising a compression retainer, said compression retainer circumferentially confining said split ring against radially outward movement.

15. The apparatus as set forth in claim 14, wherein said compression retainer comprises an adjustably tightenable substantially circular metallic band.

16. The apparatus as set forth in claim 15, wherein said compression retainer comprises a pair of substantially semi-circular metallic band portions, said pair of substantially semi-circular metallic band portions comprising opposing

attachment ear portions, said opposing attachment ear portions securable each toward the other by an adjustably tightenable fastener.

17. The apparatus as set forth in claim 1, wherein said flanged end of said  
5 outer casing extends radially outward from said outer casing to an outer end to provide an integral outer casing flange of width sufficient to provide, along a longitudinal axis, a plurality of fastener holes defined by flange interior edge wall holes.

10 18. The apparatus as set forth in claim 1, or in claim 17, further comprising a split ring backing flange, said split ring backing flange sized and shaped for close fitting engagement against said split ring.

19. The apparatus as set forth in claim 18, further comprising a plurality of  
15 fasteners having shaft portions, and wherein said split ring backing flange comprises a plurality of fastener through apertures, wherein each fastener through aperture is defined by an aperture edge wall portion, and wherein said shaft portions of said fasteners are sized and shaped for fitting through one of said fastener through apertures in said split ring backing flange and through a  
20 companion axially aligned bolt through aperture in said split ring, and wherein at least one of said plurality of fasteners is adjustably tightenable to secure said split ring backing flange and said split ring each toward the other.

20. The apparatus as set forth in claim 1, wherein the material for manufacture of said outer casing is selected from the group consisting of (a) high density polyethylene, (b) an aluminum alloy, (c) stainless steel, (d) brass, (e) carbon steel, (f) polyvinyl chloride, or (g) a moldable reinforced composite material.

21. The apparatus as set forth in claim 1, wherein the material for manufacture of said split ring is selected from the group consisting of (a) high density polyethylene, (b) an aluminum alloy, (c) stainless steel, (d) brass, (e) carbon steel, (f) polyvinyl chloride, or (g) a moldable reinforced composite material.

22. The apparatus as set forth in claim 18, wherein the material for manufacture of said split ring backing flange is selected from the group consisting of (a) high density polyethylene, (b) an aluminum alloy, (c) stainless steel, (d) brass, (e) carbon steel, (f) polyvinyl chloride, or (g) a moldable reinforced composite material.

23. The apparatus as set forth in claim 3, wherein the material for manufacture of said outer casing backing flange is selected from the group consisting of (a) high density polyethylene, (b) an aluminum alloy, (c) stainless steel, (d) brass, (e) carbon steel, (f) polyvinyl chloride, or (g) a moldable reinforced composite material.

24. The apparatus as set forth in claim 23, wherein said outer casing backing flange comprises eight bolt holes defined by edge wall apertures, and wherein said eight bolt holes are equally angularly spaced apart.

5 25. The apparatus as set forth in claim 1, wherein said first and second ring portions of said split ring are identical.

26. The apparatus as set forth in claim 25, wherein each one of said split ring portions comprises a pair of ear portions, said ear portions each having a face  
10 portion adapted for matching engagement with an identical face portion of another split ring portion.

27. The apparatus as set forth in claim 1, wherein said split ring portions each comprise a first arc portion having a first thickness on one side of said gasket  
15 seat, and a second arc portion having a second thickness on a longitudinally opposite side of said gasket seat, and wherein said first arc portion is less than one hundred eighty degrees ( $180^\circ$ ) degrees, and wherein said second arc portion is more than one hundred eighty degrees ( $180^\circ$ ).

20 28. The apparatus as set forth in claim 27, wherein said first arc portion is one hundred fifty degrees ( $150^\circ$ ), and wherein said second arc portion is two hundred ten degrees ( $210^\circ$ ).

29. The apparatus as set forth in claim 1, wherein said split ring portions each comprise a first arc portion having a first thickness on one side of said gasket seat, and a second arc portion having a second thickness on a longitudinally opposite side of said gasket seat, and wherein said first arc portion and said  
5 second arc portion are each one hundred and eighty degrees ( $180^\circ$ ), and wherein said second arc portion and said first arc portion are angularly offset by a preselected angle  $\alpha$ .

30. The apparatus as set forth in claim 29, wherein said preselected angle  
10  $\alpha$  is about thirty degrees ( $30^\circ$ ).

31. An article of manufacture comprising:

(a) a pipe having a longitudinal axis, a smooth outer wall, and an end opening;  
and

15 (b) a slip coupling forming a slidable, pressurizable fluid tight seal with said smooth outer wall of said pipe, said slip coupling comprising

(1) an outer casing, said outer casing having (A) an interior passageway, said interior passageway sized and shaped to fit therein at least some length of said pipe, and (B) a flanged end;

20 (2) a split ring, said split ring comprising first and second ring portions, said first and second ring portions each having an interior wall, said interior wall further comprising at least one gasket seat, said first and second ring portions adjustably movable between an open position wherein said first and second ring



portions open to allow attachment to or removal from said pipe, and a closed position wherein said first and second ring portions are securable in close fitting engagement around said pipe;

(3) a gasket, said gasket located at said at least one gasket seat in said  
5 inner wall of said first and said second ring portions, said gasket adapted for providing a fluid tight seal between said split ring and said smooth outer wall of said pipe;

(4) an annular seal, and wherein split ring comprises an obverse side portion, and wherein said flanged end of said outer casing comprises a flange  
10 face portion, and wherein said annular seal is sized and shaped for sealing engagement with and compression between said flange face portion and said obverse side of said split ring to provide a fluid tight seal therebetween.

32. The apparatus as set forth in claim 31, further comprising an outer casing  
15 backing flange, said outer casing backing flange sized and shaped for close fitting engagement over said flanged end of said outer casing.

33. The apparatus as set forth in claim 31, wherein said flanged end of said  
outer casing extends radially outward from said outer casing to an outer end to  
20 provide an integral outer casing flange of width sufficient to provide, along a longitudinal axis, a plurality of fastener holes defined by flange interior edge wall holes.

34. The apparatus as set forth in claim 32, or in claim 33, further comprising a split ring backing flange, said split ring backing flange sized and shaped for close fitting engagement against said split ring.

5 35. The apparatus as set forth in claim 34, wherein said split ring further comprises a plurality of longitudinally extending bolt through apertures defined by bolt hole interior walls.

36. The apparatus as set forth in claim 35, further comprising a plurality of  
10 fasteners having shaft portions, and wherein said split ring backing flange comprises a plurality of fastener through apertures, wherein each fastener through aperture is defined by an aperture edge wall portion, and wherein said shaft portions of said fasteners are sized and shaped for fitting through one of said fastener through apertures in said split ring backing flange and through a  
15 companion axially aligned bolt through aperture in said split ring, and wherein at least one of said plurality of fasteners is adjustably tightenable to secure (1) said split ring backing flange, (2) said split ring, and (3) either said outer casing backing flange or said integral outer casing flange, whichever is present, together in a leak tight assembly.

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37. The apparatus as set forth in claim 36, wherein eight through apertures are provided in said split ring.

38. The apparatus as set forth in claim 31 wherein said gasket seat comprises a recess in said interior sidewall of said first and of said second ring portions.

39. The apparatus as set forth in claim 38, wherein said recess comprises an annular groove in said interior sidewall of said first and of said second ring portions.

40. The apparatus as set forth in claim 31, further comprising a compression retainer, said compression retainer circumferentially confining said split ring against radially outward movement.

41. The apparatus as set forth in claim 40, wherein said compression retainer comprises an adjustably tightenable substantially circular metallic band.

42. The apparatus as set forth in claim 41, wherein said compression retainer comprises a pair of semi-circular metallic band portions, said semi-circular metallic band portions also having pairs of opposing attachment ear portions, said opposing attachment ear portions in each pair of opposing attachment ear portions secured each toward the other by an adjustably tightenable fastener.

43. The apparatus as set forth in claim 32, wherein said outer casing backing flange comprises ductile iron.

44. The apparatus as set forth in claim 32, wherein said outer casing backing flange comprises eight bolt holes defined by edge wall apertures, and wherein said eight bolt holes are equally angularly spaced apart.

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45. The apparatus as set forth in claim 31, wherein said split ring portions are identical.

46. The apparatus as set forth in claim 45, wherein each one of said split ring portions comprises a pair of ear portions, said ear portions each having a face portion adapted for matching engagement with an identical face portion of another split ring portion.

47. The apparatus as set forth in claim 46, wherein said split ring portions each comprise a first arc portion having a first thickness on one side of said gasket seat, and a second arc portion having a second thickness on a longitudinally opposite side of said gasket seat, and wherein said first arc portion and said second arc portion are each one hundred and eighty degrees ( $180^\circ$ ), and wherein said second arc portion and said first arc portion are angularly offset by a preselected angle  $\alpha$  ( $\alpha$ ).

48. The apparatus as set forth in claim 47, wherein said preselected angle  $\alpha$  ( $\alpha$ ) is about thirty degrees ( $30^\circ$ ).

49. An assembly for collection of landfill gas, said assembly comprising:

(a) a pipe comprising a hollow cylindrical member having smooth outer walls and an upper end;

5 (b) a slip coupling assembly, said slip coupling assembly comprising

(1) a hollow cylindrical outer casing having an interior cavity, a first open end, and a second flanged end;

(2) an annular seal, said annular seal placed adjacent said flanged end,

(3) a split flange, said split flange positioned adjacent said annular seal so as to

10 compress said annular seal toward said flanged end, said split flange further comprising a gasket seat,

(4) a gasket located in said gasket seat and circumferentially extending around said smooth outer wall of said pipe to form a fluid tight seal therebetween, and

(5) one or more backing rings and a plurality of fasteners to secure (A) said

15 flanged end of said outer casing, (B) said annular seal, (C) said split flange, and (D) said gasket, in a fluid tight relationship.

50. The apparatus as set forth in claim 49, wherein material of construction for said split flange is selected from the group consisting of (a) high density

20 polyethylene, (b) an aluminum alloy, (c) stainless steel, (d) brass, (e) carbon steel, (f) polyvinyl chloride, or (g) a moldable reinforced composite material.

51. The apparatus as set forth in claim 49, wherein the material of construction for said outer casing is selected from the group consisting of (a) high density polyethylene, (b) an aluminum alloy, (c) stainless steel, (d) brass, (e) carbon steel, (f) polyvinyl chloride, or (g) a moldable reinforced composite material.

52. The apparatus as set forth in claim 49, wherein the material of construction for said pipe is selected from the group consisting of (a) high density polyethylene, (b) an aluminum alloy, (c) stainless steel, (d) brass, (e) carbon steel, (f) polyvinyl chloride, or (g) a moldable reinforced composite material.

53. The apparatus as set forth in claim 49, wherein said slip coupling is slidable along a preselected length of said pipe, and wherein said preselected length is at least two (2) feet.

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54. The apparatus as set forth in claim 49, wherein said slip coupling is slidable along a preselected length of said pipe, and wherein said preselected length is at least ten (10) feet.

20 55. The apparatus as set forth in claim 49, wherein said slip coupling is slidable along a preselected length of said pipe, and wherein said preselected length is forty (40) or more feet.

56. The apparatus as set forth in claim 49, wherein a fluid tight seal is provided which is capable of pressurization.

57. The apparatus as set forth in claim 49, wherein a fluid tight seal is  
5 provided capable of withstanding up to one hundred fifty (150) pounds of gas pressure.

58. The apparatus as set forth in claim 1, or in claim 31, or in claim 49,  
wherein said gasket comprises a resilient material having a coefficient of friction  
10 sufficiently low that said gasket remains seated during sliding movement of said gasket over said smooth outer wall of said pipe.

59. The apparatus as set forth in claim 58, wherein said gasket material comprises a fluorolastamer.

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60. The apparatus as set forth in claim 59, wherein said fluorolastamer comprises hexafluoropropylene-vinylidene fluoride.

61. The apparatus as set forth in claim 59, wherein said hexafluoropropylene-  
20 vinylidene fluoride comprises a VITON® brand fluorolastamer

62. A method for collection of pressurized landfill gas, said method comprising:

(a) providing a pipe comprising a hollow cylindrical member having smooth outer walls and an upper end;

5 (b) providing a slip coupling assembly in a fluid tight relationship to said pipe, wherein said slip coupling assembly comprises

(1) a hollow cylindrical outer casing having an interior cavity, a first open end, and a second flanged end;

(2) an annular seal, said annular seal placed adjacent said flanged end,

10 (3) a split flange, said split flange positioned adjacent said annular seal so as to compress said annular seal toward said flanged end, said split flange further comprising a gasket seat,

(4) a gasket located in said gasket seat and circumferentially extending around said smooth outer wall of said pipe to form a fluid tight seal therebetween, and

15 (5) one or more backing rings and a plurality of fasteners to secure (A) said flanged end of said outer casing, (B) said annular seal, (C) said split flange, and (D) said gasket, in a fluid tight relationship;

(c) collecting said landfill gas within said pipe;

(d) allowing said landfill gas to traverse through said slip coupling;

20 (e) wherein during traverse of said landfill gas through said slip coupling, said pipe is allowed to move relative to said outer casing, while maintaining a pressurized landfill gas within said pipe.